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# EXPERIMENTAL PROOF OF BLEKET'S THEORY OF TERRESTRIAL MAGNETISM

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As is known, the fundamental law which relates the magnetic moment of a solid rotating body to its angular momentum was stated not long ago by Bleket, after he had compared the magnetic and angular moments of the earth, the sun, and the star 78 Davey. However, the data observed for the sun and star contain errors and, being connected with certain hypotheses which are more or less reliable, e. g., density distribution in stars, do not afford a secure basis for establishing this law. The most conclusive and natural argument for its use is the astonishing agreement, in the case of the three bodies mentioned, of magnetic moment with angular momentum, with the difference of the moments themselves being $10^{10}$ times.

On the other hand, if this law is correct, then it should affect our basic physical concepts and theories of gravitational and electromagnetic fields. Thus, every new possibility of proving Bleket's law takes on a correspondingly greater value. Only from this point of view should an approach be made to effecting its immediate experimental proof. This was attempted by Hales and Gougogh.

The experiment they conducted is interesting chiefly in that it avoids the basic difficulties inherent in the method presented earlier, which necessitated creation of laboratory objects with a sufficiently large angular momentum and application of insufficiently founded hypotheses by using data relating to stars or planets.

The idea conceived by Balard is a very simple one and is based on the fact that in various mechanisms the generation of the earth's magnetic field should correspond to various laws of variation in the magnetic field intensity as a function of the depth of a submerged instrument in the earth. The authors show that the calculation of the horizontal component $H_d$ of the earth's magnetic

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field intensity $H_o$ as a function of depth, for the correct application of Bleket's law and for the correct theories that explain the earth's magnetism by taking the earth's core into consideration, leads to the following expression:

$$H_d = H_o\left\{1-2\left(\frac{5\rho}{\rho}+1\right)\frac{d}{a}\right\} \text{ (Bleket's theory)}$$

and

$$H_d = H_o\left(1-3\frac{d}{a}\right)$$

(central core theory). Here $H_o$ is the magnetic field intensity at a depth d, a is the earth's radius, $\rho_1$ is the average density of the earth in the layer from the surface to a depth d, and $\rho$ is the average density of the earth.

In particular, for a depth d = 1.5 kilometers, we get

$$H_d - H_o = -26\,\gamma \quad \text{for Bleket's theory}$$

$$H_d - H_o = +11\,\gamma \quad \text{for the central core theory}$$

(We will remember that 1 $\gamma$ = $10^{-5}$ gauss. The average magnetic field intensity of the earth is about $5.10^4\,\gamma$. Variations generally are several tenths, but sometimes even a thousand $\gamma$.)

Later, by a more exact investigation Chapman arrived at a somewhat different expression for the correct use of Bleket's theory:

$$H_d = H_o\left\{1-3\left(\frac{5\rho_1}{k\rho}-1\right)\frac{d}{a}\right\}$$

Here k = $I/I_o$ where I is the earth's moment of inertia, and $I_o$ is the moment of inertia of a globe with the same dimensions and mass, but constant density. Assuming $\rho$ = 5.5, $\rho_1$ = 2.8, and k = 0.88, it gave for d = 1.5 kilometers:

$$H_d - H_o = -21\,\gamma$$

It is obvious immediately that even though the effect is insignificant, it can be completely measured in accordance with known techniques; however, the authors themselves could not supply the necessary accuracy; hence their measurements should be considered only approximate.

Measurements were made in shafts with the aid of Shmidt's horizontal magnetometer. Data was obtained two or three times (on various days) for five different points, whose average depth was 1.5 kilometers. The calculation of the variation in magnetic field intensity was made with a similar apparatus on the surface.

The basic fault of the measurements was the instability of the indicator. As shown by the authors, the readings, both before and after the apparatus was lowered into the ground, varied from 14 to 22 to 32 $\gamma$ in the calculations of the variation for three different days.

To calculate the error, the authors adopted the following method:

1. It was assumed that this difference was the result of inaccuracies of the instrument and $H_d$ - $H_o$ was calculated as an average value obtained before and after lowering the apparatus into the shaft.

2. It was assumed that the divergence increased linearly with time.

Both methods gave almost corresponding results.

The average for all 50 measurements of $H_d$ - $H_o$ was

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$H_d - H_o \quad = \quad (-26 \pm 4\,\gamma$ for assumption 1)

and

$H_d - H_o \quad = \quad (-24 \pm 4\,\gamma$ for assumption 2)

The measured results are in obvious agreement with Bleket's theory. Before making a closer comparison, the influence of local geological structure must be calculated. In the experimental arrangements, this influence should lower the absolute value of $H_d - H_o$ by a minimum of $6\,\gamma$ and a maximum of $14\,\gamma$, i.e., values for $H_d - H_o$ are obtained which are included between $-11 \pm 5\,\gamma$ and $-19 \pm 5\,\gamma$.

Thus, the variation in the earth's magnetic field intensity with depth vitiates those theories which would explain the earth's magnetism by processes occurring in the earth's central core. On the other hand, the deviations of the observed values of $H_d - H_o$ from the values predicted by Bleket's theory are quite insignificant. The authors showed that this deviation decreases if more elaborate calculations of the geological construction of the region are made, and also if one takes the following circumstances into consideration: In Rankoon's formulas, the depth is calculated from the average of the entire earth's surface. Actually the area where the calculations were made was 1,600 meters below sea level. Such local variations in the earth's surface and shifting of the calculation point relative to the center of the system should bring about certain changes in the theoretical value of $H_d - H_o$ and in the direction of increasing its absolute size.

Summarizing, it can be said that although Hales' and Gougogh's measurements favor Bleket's theory, they cannot serve as indicators of its correctness. It is to be expected that only accurate measurements, made at various depths and at various points on the earth's surface, will determine the correctness of Bleket's theory.

BIBLIOGRAPHY

1. P. M. Bleket, U. F. N., 33, 52 (1947).

2. A. L. Hales and D. I. Gougogh, Nature, 160, 746 (1947).

3. S. Chapman, Nature, 161, 52 (1948).

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